③

AD-A285 376

Instructional Hypermedia as a Method to Train Electronic Warfare Personnel

OCT 11 1994
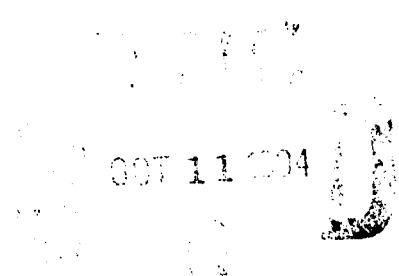
Michael B. Cowen

94-31940

Instructional Hypermedia as a Method to Train Electronic Warfare Personnel

Michael B. Cowen

Accesion For		
NTIS CRA&I		☒
DTIC TAB		☐
U announced		☐
J tio.1		
By		
Di t ib tio /		
Availability Codes		
Dist	Avail and / or Special	
A-1		

Reviewed by
Orvin Larson

Approved and released by
J. C. McLachlan
Director, Training Research Department

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE September 1994	3. REPORT TYPE AND DATE COVERED Final—1 Oct 91-31 Sep 93

4. TITLE AND SUBTITLE
Instructional Hypermedia as a Method to Train Electronic Warfare Personnel

5. FUNDING NUMBERS
Program Element: 0603707N
Work Unit: 0603707N.R1772.ET103

6. AUTHOR(S)
Michael B. Cowen

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Navy Personnel Research and Development Center
53335 Ryne Road
San Diego, CA 92152-7250

8. PERFORMING ORGANIZATION REPORT NUMBER
NPRDC-TN-94-19

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Chief of Naval Personnel
Special Assistant for Research Management (PERS-00H)
Navy Department
Washington, DC 20370-0000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Functional Area: Training
Product Line: Operational Training
Effort: Surface Combat Operator Training

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE
A

13. ABSTRACT *(Maximum 200 words)*

The goal of the naval electronic warfare technician is to match intercepted signal parameters with the names of specific emitters and their associated platforms. It was hypothesized that an instructional hypermedia-based training system will improve the electronic surveillance technician's ability to classify emitters. The training system provides opportunities for the technician to interact with a simulation of the electronic surveillance environment. A graphic representation of the console of the electronic surveillance device was presented to the technician. The training procedure consisted of hooking an emitter symbol and selecting various multi-media representations of the emitter including sound, text, digitized photographs, and animated graphics. Emitter classification training was administered to 48 subjects using either instructional hypermedia or a printed listing. The training using the instructional hypermedia was found to be more effective than the training using the printed listings.

14. SUBJECT TERMS
Hypermedia, Training Systems, Electronic Surveillance, Electronic Warfare, AN/SLQ-32, Instruction, Cooperative Learning, Computer-Based Training, Classification Training

15. NUMBER OF PAGES
14

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED

Foreword

This report provides preliminary results on the benefits of incorporating hypermedia into a Navy instructional delivery system and determines the effectiveness of instructional hypermedia as a method to train electronic warfare technicians to classify emitters. This instructional technology is intended for use by Navy training personnel responsible for designing computer-based training systems.

J. C. McLACHLAN
Director, Training Research Department

Contents

Introduction

Background and Problem

The AN/SLQ-32 (V) is an electronic warfare (EW) antiship missile defense system. It is an electronic surveillance measure (ESM) device with computer-aided processing for automatic and instantaneous identification of intercepted signals. Although its main purpose is to augment the defense of the battle group against antiship missiles, the AN/SLQ-32 is designed to detect all radio emissions in three band widths at all azimuths, covering all possible radars (Blake, 1989).

Detection and interception of electronic signals using the AN/SLQ-32 is performed by the EW technician. Since the AN/SLQ-32 does not always correctly classify an intercepted signal, the EW technician must be able to confirm an automatic identification of an electronic emission by the AN/SLQ-32. The cognitive goal of the EW technician is to match intercepted signal parameters with the names of specific emitters (e.g., radars, missiles) and their associated platforms (e.g., ships, aircraft). Accurate identification of all intercepted electronic emissions is vital to ship defense.

Objective

The objective of this project was to design, develop and test a training intervention to improve the EW technician's ability to classify emitters.

Approach

Instructional Hypermedia

Although introducing technology into the training environment does not necessarily enhance learning (Clark, 1983), incorporating hypermedia into an instructional delivery system may increase the effectiveness of Navy training (Conklin, 1987). A hypermedia system is a computerized database consisting of text, graphics, video, and sound. The database consists of a system of nodes and links. Nodes store a quantity of information. Users navigate through the system of nodes via links. The hypermedia system creates a structuring of the data or a knowledge base. Hypermedia may create an effective learning environment because users actively associate knowledge when searching paths and retrieving information (Anderson, 1988).

This research tested the hypothesis that an instructional hypermedia-based training system will improve the EW technician's ability to classify emitters. The proposed training provides opportunities for the technician to interact with a simulation of the electronic surveillance environment. The training is self-paced and under learner control. A graphic representation of the AN/SLQ-32's console displaying numerous emitter symbols is presented to the technician. The training procedure consists of hooking a symbol and selecting various multi-media representations of the emitter including sound, text, digitized photographs, and animated graphics which enables the technician to link digital parameters to concrete images of radars, platforms, and weapon systems. The technician can hook more than one emitter so that representations can be compared and contrasted. This approach will help the technician identify emitters and their respective platforms because interactions with the instructional hypermedia will create elaborate associations (Reigeluth & Stein, 1983) of the emitter information in memory.

A computer-based lesson incorporating the instructional hypermedia approach was developed for a database of 35 emitters. The instructional hypermedia was tested in two phases. Experiment I tested for immediate recall of the to-be-learned material and Experiment II tested for recall of the to-be-learned material immediately and 2 days after the intervention, and also included a cooperative learning treatment group.

Treatment Group

Treatment group subjects received a computer-based emitter classification lesson incorporating the instructional hypermedia. The lesson consists of two parts: Freeplay and Drill. The Freeplay displays the AN/SLQ-32's console to the user. An example of emitters displayed on the "wagon wheel" of the AN/SLQ-32 during Freeplay is sketched in Figure 1. During Freeplay, the subject clicks on emitter symbols using a mouse and then selects sound, picture, animated graphic, and textual representations of the emitter. During Drill, the user practices associating emitter parameters with radars and platforms. For the emitter parameters displayed, the user selects the correct radar and platform. Feedback is provided for every response. The treatment lasted about 25 minutes.

The emitter is a SPS-67 surface search radar, a solid state G/H/band system designed to replace the SPS-10. The system is in full production for the U.S., German, and Australian navies.

BRG: 085
FRQ: 99999
PRF: 99999 STD
SCN: 99999 MS

The guided missile cruiser HORNE (CG-30) is in the Belknap class of cruisers. It has a displacement of 7,930 tons when it is fully loaded. It is 547 feet long, carries 477 personnel, and cruises at about 33 knots.
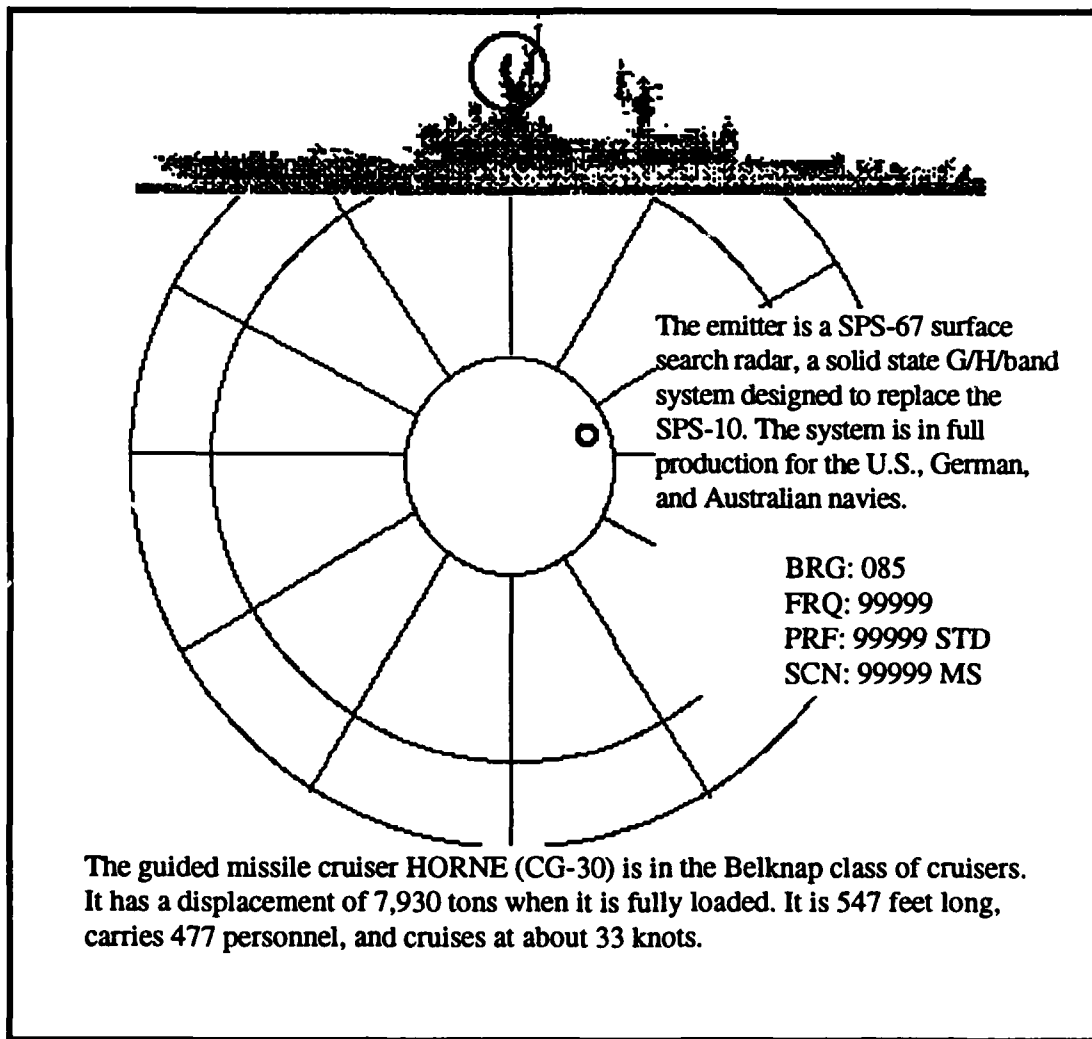
Figure 1. An instructional hypermedia display.

Control Group

Control group subjects received an alternative emitter classification lesson that resembles training that might be provided prior to a warfare exercise. Subjects were required to learn the emitter data base from a printed listing. The data are in notebook form and resembles an Electronic Order of Battle. The control training lasted about 15 minutes.

The subjects in both groups were administered a test prior to and after the intervention. The test contains 64 multiple choice items that are presented randomly; 35 items require the subject to identify the correct radar when given the emitter parameters; 29 items require the subject to identify the correct platform when given the radar.

Design

Experiment I consisted of two sessions, 2 weeks apart. During the first session, the subjects were administered the multiple choice test. During the second session, the subjects received either the hypermedia or the control training, immediately followed by the multiple choice test

Experiment II consisted of two sessions, 2 days apart. During the first session, the subjects were administered the multiple choice test, the hypermedia or control training depending on their group, and the multiple choice test again. During the second session, the subjects received only the multiple choice test.

Most of the subjects during the Experiment I hypermedia training volunteered specific comments about the emitters and associated multimedia representations to the experimenter. They wanted to provide some elaborative information about the displayed emitters. For example, "I saw that radar on a destroyer last year in the Persian Gulf" and "That radar is very similar to the radar aboard my ship" were said to the experimenter. This reaction to the hypermedia lesson may be due to its similarity to the operational environment (i.e., on the job) where much of the training for electronic surveillance devices is provided. In this environment the EW technician must successfully interact with other surveillance personnel as well as the other Combat Information Center personnel. To utilize this interaction, the hypermedia training intervention was tested in a cooperative learning setting (i.e., a cooperative learning treatment group) in Experiment II. Prior research indicates that subjects working together will recall and synthesize more information than they could working alone (Webb, 1990).

Subjects in the cooperative learning group were individually pretested and then randomly subdivided into pairs. The hypermedia training was administered to the pairs, but the subjects received the posttests individually. It was predicted that the treatment group and the cooperative learning treatment group would significantly outperform the control group on the post-intervention tests.

Results

Twenty subjects were tested for Experiment I and 28 were tested for Experiment II. For Experiment I, data was analyzed for 10 treatment subjects and 7 control subjects. Two Experiment I subjects did not return for the second session and one Experiment I subject's data were lost due to a computer malfunction. For Experiment II, data was analyzed for 8 treatment subjects, 9 cooperative learning subjects, and 8 control subjects. Three Experiment I subjects did not return for the second session.

3

Experiment I—Mean test score by training group is shown in Figure 2. After training, the treatment group's score increased 18% ($t[9] = 6.39, p < .001$) while the control group's score increased 7% ($t[6] = 11.21, p < .001$). The treatment group's performance gain was significantly higher than the control group's performance gain ($F[1,14] = 15.73, p < .001$).

Experiment II—Mean test score by training group is shown in Figure   nmediately after training, the treatment group's score increased 20% ($t[7] = 6.86, p < .001$), cooperative learning increased 13% ($t[8] = 4.61, p < .01$), and the control group's score increased 7% ($t[7] = 3.10, p < .05$). The treatment group's immediate performance gain was significantly higher than the control group's immediate performance gain ($F[1,13] = 13.20, p < .01$). Although the cooperative learning group's immediate performance gain was higher than the control group's immediate performance gain, the difference was not statistically significant.

Each group's performance declined somewhat 2 days after training. When compared to the pretest score, the treatment group's score increased 17% ($t[7] = 8.04, p < .001$), cooperative learning group's score increased 14% ($t[8] = 4.33, p < .01$), and the control group's score increased 6% ($t[7] = 2.44, p < .05$). Again, the treatment group's performance gain was significantly higher than the control group's performance gain ($F[1,13] = 11.49, p < .01$). The cooperative learning group's performance gain was higher than the control group's performance gain, but again this difference was not statistically significant.

Discussion

Training was developed to improve the EW technician's ability to classify emitters. Two training modules were developed: One using an instructional hypermedia approach (the treatment) and the other using a traditional approach (the control). Subjects were trained using instructional hypermedia in pairs and alone. Subjects were tested prior to, immediately after, and again 2 days after training. Technician performance improved significantly for both hypermedia and control groups even 2 days after training. The hypermedia was effective for training subjects in pairs or individually.

Training using instructional hypermedia was found to be significantly more effective (11% better) than training using print only (i.e., control group) when provided to individuals working alone. Administering the training in a cooperative setting did not add to hypermedia group performance. However, the hypermedia training in a cooperative setting group performed 8% better than the control group. Even though this difference is not statistically significant, it is encouraging. Previous investigations of computerized instruction in academic settings have found that performance improved when students were paired (Dalton, 1990; Stephenson, 1992). Cooperative pairs of students were better able to reorganize and clarify, guide and correct, and build on each other's ideas. Students working in cooperative learning environments have been found to have reduced anxiety, an increased willingness to ask for help, and an increased willingness to take feedback seriously compared with students working alone. A closer examination of the effects of instructional hypermedia in cooperative settings is needed to further define this issue.

Hypermedia technology applications have become widespread and are a suitable candidate for delivering emitter classification training. In response to post-training questions, all subjects in the treatment groups thought that the instructional hypermedia helped their performance and should be implemented. Moreover, responses to post-training questions revealed that the instructional
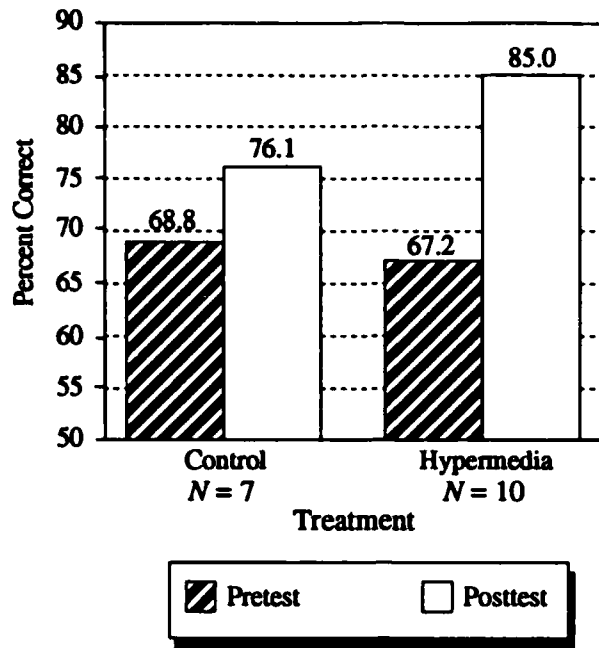
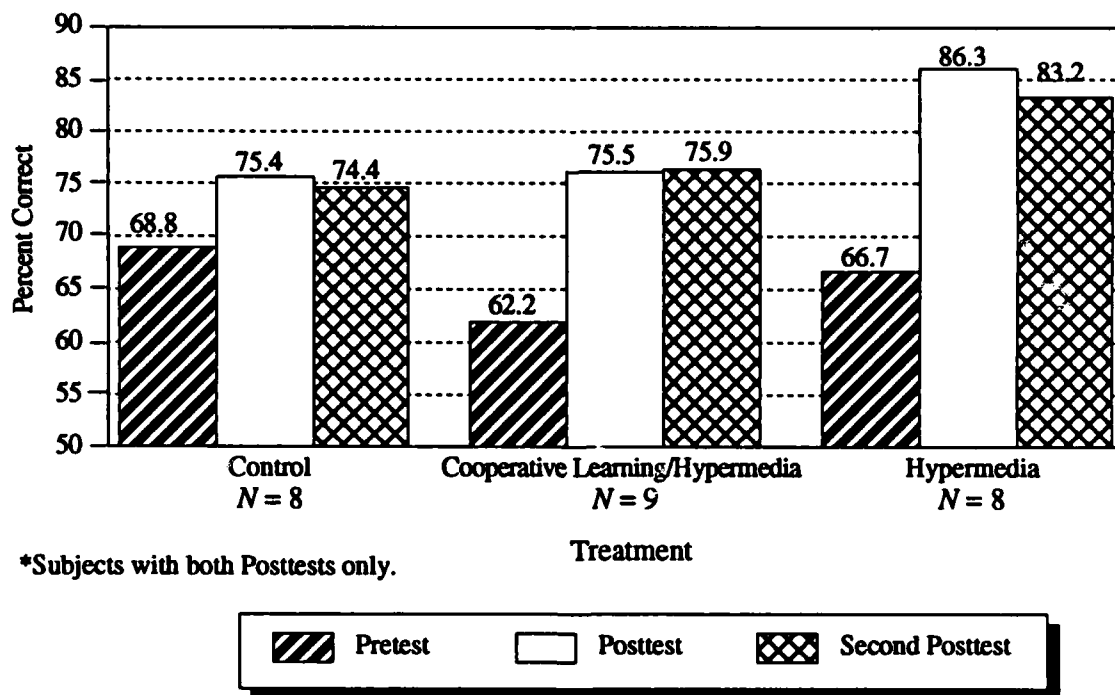**Figure 2. Mean performance by training group (Experiment I).**

*Subjects with both Posttests only.

Figure 3. Mean performance by training group (Experiment II*).

5

hypermedia was easier to use ($t[32] = 2.11$, $p < .05$) and more enjoyable ($t[30] = 3.43$, $p < .002$) than the control training. Further, when given a choice of training, all control subjects who were shown the treatment (after the posttest) preferred the instructional hypermedia over the control training.

Conclusions and Recommendations

Our investigation provides evidence for using instructional hypermedia for training EW personnel to classify emitters. In addition to validating an instructional technology approach, a considerable step was made toward designing a practical system for training. With appropriate attention to implementation, this computer-based instructional system could improve naval antiship missile defense and surveillance.

References

Anderson, T. (1988). Beyond Einstein. In S. Ambron and K. Hooper (Eds.), *Interactive Multimedia: Visions of Multimedia for Developers, Educators and Information Providers.* Redmond, WA: Microsoft Press.

Blake, B. (1989). *Jane's radar and electronic warfare systems 1989-90.* Surrey, England: Jane's Information Group.

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research, 53,* 445-459.

Conklin, J. (1987). Hypertext: An introduction and survey. *IEEE Computer, 20,* 17-41.

Dalton, D. W. (1990). The effects of cooperative learning strategies on achievement and attitude during interactive video. *Journal of Computer Based Instruction, 17,* 8-16.

Stephenson, S. D., (1992). The role of the instructor in paired computer-based training. *Proceedings of the 34th Annual Conference of the Military Testing Association, 1,* 414-419.

Reigeluth, C. M., & Stein, F. S. (1983). The elaboration theory of instruction. In C. M. Reigeluth (Ed.), *Instructional design theories and models: An overview of their current status.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Webb, N. M. (1990). Peer interaction and learning with computers in small groups. Computers in *Human Behavior, 3,* 193-209.

Distribution List

Chief of Naval Personnel (PERS-00H), (PERS-05)
Chief of Naval Research (Code 342), (Code 01)
Defense Technical Information Center (DTIC) (4)